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and to substitute for it work bearing directly on the "personality study" which these physicians are required to make of their wards.

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GENERAL BIOLOGY AND THE JUNIOR COLLEGE

BIOLOGISTS are much indebted to Professor Nichols for his excellent summary of sentiment in respect to the so-called "General Biology" course. His survey would appear to indicate that possibly a majority of biologists believe that a year's work, consisting of a half year each of introductory botany and zoology, is general biology or is at least a preferable substitute for it. In a recent article Professor Henderson expresses his dissent from this view and raises the question of the relation of this course to general culture and the junior college. He says:

I take it as axiomatic that there is a certain minimum of information regarding matters biological which every educated man ought to have . . .

and

It seems—at least some of us hope—that to-day we are about to see a displacement of the academic course in favor of the junior college, which would give such general subjects as the languages, American history, elementary chemistry and physics, and the one or two other things which every one should have; . . .

The Junior College.—That there is already a strong current of sentiment toward the junior college is a fact of which one can scarcely remain unaware. For this there appear to be several reasons. In the first place many of the larger universities are fairly swamped with students of immature age in respect to the nature and content of the courses offered them. A second and possibly more important reason is that such junior colleges can be established and maintained in most larger towns and cities. This results in a desirable saving in expense to the student. Its chief advantage to the university lies in

the fact that it frees it from overcrowding and acts as a desirable preliminary period during which there is likely to occur a sorting out of the students better qualified by ability and interest to pursue the professional courses of the university.

In the third place our universities are showing stronger and stronger tendencies away from "general culture" courses. To the small college is left, in large measure, the task of imparting general culture. Modern education consists, then, either in a series of years devoted wholly to general culture, or in an equal period of specialized, more or less technical study, the determining factor being whether the student happened to attend a small college or one of the larger universities. The exigencies of modern life forbid, in the case of many individuals, and render of doubtful value for others, the spending of four years in acquiring general culture. On the other hand, a curriculum devoted wholly to specialized training is thought by many intelligent persons not to afford a liberal education, at least in the best sense of that term. The junior college offers a feasible, if not an ideal, solution of the difficulty by allowing (or perhaps requiring) two years of general culture on which may be superposed two or more of specialized training.

An important feature of the junior college which commends it to many is the limited election which its organization permits. The immature student may well be compelled to form acquaintance in an elementary way with the subject matter of the chief lines of human endeavor, and, what is more important, with the point of view and habits of thought of workers along these lines. Too free a range of election in the earlier years hinders this attainment of broad outlook by tempting the student to follow along familiar pathways. With distressing frequency is the spectacle presented of students clinging to certain groups of courses because they feel reasonably sure of success therein, whereas their own best educational interests demand that they venture into strange fields and feed on untried pabulum.

Whether the first two college years are given on the university campus or in a separate junior college it seems highly desirable to reconsider the nature and content of their courses. As matters now stand in the larger institutions there are likely to be from twenty to thirty separate departments of instruction, each of which offers an elementary course introductory to its particular field of investigation. Under these circumstances the student finds it difficult or impossible to acquire a *general knowledge* of the fields of human endeavor. It is true, of course, that most departments aim so to construct their introductory courses as to make them suitable foundations for further and more specialized work and at the same time afford as much general information and training as possible. The truth, in the opinion of many, is that this double object is very difficult, or perhaps impossible, of satisfactory achievement. It is the old, old problem of serving two masters and usually with "General Culture" cast for the rôle of Mammon. The general result is that there are numerous excellent courses in every university, considered from the point of view of introductions to their respective subjects, but very few general culture courses worthy the name. But even granting that some do achieve this two-fold object and that all might do so, it still remains true that the student must take too many courses to secure what he desires and must learn many specialized facts and acquire special technique which he neither ardently desires nor particularly needs.

If, now, the case against the growing extreme specialization in the first two college years has been fairly put, we are faced with the problem of attempting a resynthesis of the subject matter of elementary courses which will at once reduce the number of courses and broaden their outlook. The chief aim should be to remove them from the field of specialization to that of general culture; to make them fit into the general educational scheme of the genuinely well-educated man. However, sight must not be lost wholly of the fact that these junior college courses will

constitute, also, the collegiate introduction, in some cases, to the specialized lines of study to be pursued later. To be specific, the general biology course must not only present a broad view of the field of biology to the general culture student but should also make clear to the future physician, agriculturist, or scientific investigator the relation of his special field of effort to that larger domain of which it is but a specialized part.

Before considering the specific application of these general ideas to the question of elementary instruction in biology it seems desirable to raise and discuss two preliminary inquiries: (1) What is wrong with the "General Biology" courses of the past? (2) Why are the usual consecutive courses in botany and zoology regarded as unsatisfactory?

The Case against "General Biology."—Careful reading of Professor Nichols's paper shows that the objections to general biology are directed, for the most part, against the "standard" course, based originally on the text-book of Huxley and Martin; but with an undercurrent of opinion that no course can avoid certain pitfalls, among which are: the difficulty of finding men of sufficient breadth of view to give general biology adequate presentation; the equally serious difficulty of finding zoologists and botanists who can cooperate harmoniously in giving a course jointly; the danger that abstract principles may be stressed unduly, to the exclusion of concrete facts; and finally, the alleged unsuitability of general biology as an introduction to further study of zoology or botany. Disregarding, as we should, those objections that are based on interdepartmental or inter-professional jealousies, and assuming, as we may, that zoologists and botanists will cooperate willingly, if the need for such cooperation becomes clear, the problem boils down to the question whether a "General Biology" course properly designed to afford a maximum of general culture would also be a useful and desirable introduction to his field for the future botanist, zoologist, or physician.

Objections to Consecutive Courses in Botany and Zoology.—Consecutive courses usually are

not, and generally are not intended to be, adequate presentations of general biology. On the contrary these courses are commonly admirable introductions to the sort of botany or zoology taught in their respective institutions. They are open to criticism from two directions. In the first place they contain much that is of little interest or importance to the general culture student and they usually involve an excessive amount of detailed laboratory work for this type of student. We do not mean to assert that a thorough training in the laboratory is not good for any sort of student but merely to point out the absurdity of compelling him to acquire a different one for each field of study if he is to become a really well educated man. Not unnaturally the majority of students, under a system of relative freedom of election, decline to attempt to secure a general education at this exorbitant price.

On the other hand these courses are seriously deficient, from this point of view, in what they omit. This is more serious than the inclusions, for one may reasonably be willing to pay an excessive price for a worthwhile article but he can hardly be expected to be satisfied to pay for what he ardently wishes and really needs and then not get it, even after being overcharged.

Furthermore this criticism comes not alone from the general culture student but also from one of the largest groups of biologists, namely, the medical students. The tandem arrangement has never been satisfactory to them, and now, with the increasing pressure upon their time for technical zoological courses, such as comparative anatomy, becomes virtually impossible. The present situation is that the prospective medical student takes no botany at all, or does so only at the sacrifice of valuable and important non-scientific study, of which he obtains at best far too little. And furthermore, whether he studies botany or not, he goes through his course without having had formal opportunity to acquire a broad conception of life itself and the interrelations of living things with one another and with the inorganic world.

What is General Biology.—To the writers it seems clear that it does not consist in some zoology and some botany, whether administered in the old-fashioned mixture, improperly called general biology, or in the more modern separate dose method of consecutive courses. To us it seems axiomatic that it must have a much broader outlook and that it must in a general way include somewhat the following topics: (1) The structures and functions common to all living things; (2) The distinguishing characteristics of plants as such and their function in the world; (3) The essential characters of animals; (4) The interrelations of plants and animals with one another and with inorganic nature, with special reference to competition, survival, injury, death, disease, and decomposition; (5) The processes of nature whereby matter and energy are so conserved and transformed as to permit the ceaseless and indefinitely continuous round of life. To be more specific this means a study of: (a) Protoplasm—its structure and functions, cells, cell division, colonial and multicellular organisms, growth and differentiation; (b) the rôle of green plants in the transformation of the free energy of sunlight and simple inorganic compounds into complex energy-containing organic compounds to be used as foods—*i. e.*, as sources of energy and building materials—by animals and non-green plant cells; (c) how these foods are used by animals in growth and work and how they produce wastes, eventually to be used again by plants; (d) the sensitivity of protoplasm and its rôle in relating the plant and animal to their environment; (e) growth and reproduction; (f) heredity and evolution; (g) disease and death; (h) decomposition, putrefaction, and fermentation and other processes in the soil that render organic materials again usable by green plants; (i) the transformations and conservation of matter and energy as exemplified in the carbon, nitrogen, and other organic cycles.

Administrative Difficulties.—It seems probable that much of the prejudice against the "General Biology" course has actually had its origin in the inter-departmental friction

of administering a large joint undertaking. We have no doubt that this can be overcome, with patience and good will, even with the present organization of our chief universities. But, on the other hand, these difficulties are greatly minimized under a junior college organization. Presumably in most institutions the first two years work would be placed directly under the control of a dean or other similar administrative officer with little or no departmental bias. He would be empowered and obligated to organize such general courses—General Biology and others—without interference from departments or technical schools, though he would doubtless wisely seek such advice as he needed.

Under a junior college organization, general biology is but one of the urgent needs. A presentation of the general concepts of physics and chemistry is certainly just as much needed and doubtless equally feasible. Certainly the educated man should know something of the earth on which he lives and the planetary system to which it belongs—interesting subject matter for a general course. It is possibly venturing afield for biologists to suggest that a general course could also be devised that would inform the student concerning the human environment in which he lives. What a fascinating course could be made by a serious attempt to set before the student the rôle of the state, the church, labor, capital, eugenics, and euthenics!

In conclusion the writers, a botanist and a physiologist, respectively, would beg to record their conviction not only that a course in general biology, and other similar courses, can be organized and that they are highly desirable but also that the advance of the junior college will shortly force us to attempt it whether we like it or not.

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FRANCIS C. PHILLIPS

DR. FRANCIS CLIFFORD PHILLIPS died at his residence, 144 Ridge Avenue, Ben Avon, Pa., on Monday, February 16, of influenza-pneu-

monia, passing away in the same peaceful manner which characterized his life.

He was born in Philadelphia, April 2, 1850, the son of William S. and Fredericka Ingersoll Phillips. He received his early education at home from an unusually capable and devoted mother. In 1864 Dr. Phillips studied at the Academy of the Protestant Episcopal Church in Philadelphia and in 1866 entered the University of Pennsylvania, where he obtained his A.B. From 1871-1873 he studied under Regimus Fresenius at Wiesbaden, Germany. During the latter year he was private assistant to Professor Fresenius. He then spent a year at the Polytechnic School at Aachen (Aix-la-Chapelle). Here he was associated with Professor Landolt. Professor Phillips was unable to complete his studies abroad because of the poor health of his father. He returned to America and during the following year became instructor in chemistry at Delaware College. In 1875 he was appointed to the teaching staff of the University of Pittsburgh, then the Western University of Pennsylvania, where he taught for forty years, retiring as head of the Department of Chemistry in 1915. For many years he taught chemistry, geology and mineralogy. Even in the writer's student days (1898-1902) Professor Phillips still taught all branches of chemistry and mineralogy. In 1878-1879 he also lectured to the students in the Pittsburgh College of Pharmacy, where he succeeded the late Professor John W. Langley, a brother of the late Samuel P. Langley, then at the Allegheny Observatory and afterwards secretary of the Smithsonian Institution. In 1879 he received the degree of A.M. from the University of Pennsylvania, and in 1893 the Ph.D.

He was married in 1881 to Sarah Ormsby Phillips daughter of Ormsby Phillips, a former mayor of Allegheny.

In 1915 Dr. Phillips retired from active service in the University of Pittsburgh under the pension system of the Carnegie Foundation. Since that time he had been engaged continuously in research and writing in a laboratory provided by the Mellon Institute. During the recent war he conducted researches